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AN IRON RANGE WATER SYSTEM: CHISHOLM[1]

By C. J. Sullivan[2]

In order to deal as concretely as possible with the problems to be solved in connection with the production and sale of pure water, it may be of value to indicate briefly some of the difficulties encountered in the development of the plant at Chisholm.

Chisholm is situated on the west shore of Longyear Lake and has a population of 9000 people. The water works are municipally owned and operated and are governed by a Board of Commissioners. When the author took charge of the water works and filtration plant as superintendent thirteen years ago, the condition of the plant was deplorable. The equipment consisted of a Worthington 600-gallon-per-minute fire pump, a wooden elevated tank with a capacity of 37,000 gallons, giving a maximum pressure of only 65 pounds at the pump station, the lowest elevation, a 1,000,000-gallon mechanical gravity filter of two concrete units, only one of which was equipped and in working condition at that time, and a 100-horse power, return tubular boiler that had not been cleaned since it was installed. The reason advanced for this last condition was that with only one boiler, the time limit on the filtered supply of 50,000 gallons was not sufficient to warrant a shut-down with the limited capacity of the wooden tank and the small suction well.

Permission was obtained from the electric light company to connect to one of the boilers of its plant located about 200 feet north of the village boiler room. By running a 4-inch pipe line from the header of the water works boiler to theirs, paying a flat rate for the steam, it was possible to shut down for three days and make a thorough cleaning. Before doing this, however, a 24-hour test run was made on coal consumption, which showed 3 tons used for the 24-hour period. After cleaning and making some changes to the open heater, a second similar test showed a coal consumption of slightly less than a ton for the 24-hour period. This effected a saving, based on the price of coal at that time, of over $4000 per year.

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[1] Read at the Duluth meeting of the Minnesota Section, November 6, 1920. Discussions are invited and should be sent to the Editor.

[2] Superintendent Water Works, Chisholm, Minn.

The raw water supplied to the filters was pumped from Longyear Lake, which was in a very bad state of pollution, as it received then and had been receiving for two years prior to that time, the raw sewage from the village. This was in the late fall of 1907, but with careful operation it was possible to get along with this supply until the following April, when a supply line for the filters was laid to the Monroe Mine.

This lake water was high in color and had an alkalinity of 17 parts per million. The author's predecessor was using 15 grains per gallon of aluminum sulphate. Immediately the aluminum sulphate was cut down to 1½ to 2 grains per gallon and milk of lime was added to the amount of 0.5 grain per gallon, and the results were very satisfactory. To make this change it was necessary to discharge two filter operators, political appointees, who were adverse to education. Experience in this connection emphasizes the desirability of licensing filter operators to insure the employment of competent men.

The present equipment consists of a 2,000,000-gallon filtration plant in four units, the old filter having been repaired and remodeled. The wooden solution tanks have been replaced with concrete, new chemical feeding orifice boxes installed, and two new electrically driven, submerged, sludge pumps set up for cleaning the sedimentation basins, which under the present conditions is done twice each year. Floats and gauges were installed where needed. A 300,000 gallon concrete clear well, a 300,000-gallon elevated steel tank giving a maximum pressure at the pump station of 95 pounds have been built, and also a 400,000-gallon concrete raw-water storage and sedimentation basin in duplicate, one equipped with baffles installed to determine what effect there would be on the time run on the filters by using the basins alternately. In cleaning the basins, it was found that the one equipped with baffles contained considerable iron sludge, while the other without the baffles was free from sludge, showing that the sludge was carried down from the basin and removed at the filter plant.

Duplicate feed lines from the raw water storage basins supply the filters, 7000 feet of 14-inch steel pipe connect the raw water storage basins with the discharge line of the deep mine pump at the surface of A shaft, Monroe Mine. There is also an emergency 8-inch cast-iron pipe line to the same shaft.

All told there are 18½ miles of water mains, 9 miles of ¾-inch services, 110 fire hydrants, 347 gate valves and 1244 service taps. All water mains are laid on the north side of the street and every second avenue is gridironed. The mains are laid 18 feet from the property line and each block is controlled by a standard gate valve, installed in line with the intersection of the avenue. By this method a green man has no difficulty in shutting off the water because of his inability to find the valve. His instructions are to measure 18 feet from the property line on the street intersection in line with the avenue. Each hydrant is controlled by an independent valve. There is a record of every curb valve and no trouble is experienced in finding any one of the 1244 installed to date, should they become snowed under or covered over with dirt by the street gang.

No applications for water main extension are honored unless the applicant guarantees the department that a service connection will be made for each 100 feet of water main laid. A start was made a year ago to install meters, and within the next two or three years the system will be 100 per cent metered.

For the month of October, 1919, the water output was 24,267,000 gallons as against 20,263,000 gallons for October, 1920, or a saving of over 4,000,000 gallons of water per month made by replacing a badly leaking 8-inch main. The readings are taken daily from a Simplex valve meter installed in the office of the superintendent.

The water collected underground at A shaft, Monroe Mine, is the mine drainage, and when pumped to the village is often highly colored, very turbid, and contaminated with sewage organisms. After a period of sedimentation, it flows by gravity to the filters, where it is treated with aluminum sulphate as it enters the mixing chamber, the records showing an average of 0.67 grain per gallon applied for the month of October, 1920. It then passes through baffles to the sedimentation basins of the filters, having a flowage of six hours. The effluent from the filters is free from color, and a very high percentage of the bacteria is removed. From the clear well the effluent flows to a small concrete suction well, where the water as it enters the suction of the pumps is dosed with chlorine gas in the amount of 0.14 part per million. The chlorine gas apparatus was installed in 1915, and to the best of the author's knowledge was the first of its kind installed in Minnesota. Previous to the installation of the apparatus, the effluent from the filters was treated with hypochlorite of lime by apparatus installed under the supervision of H. A. Whittaker, director of the Division of Sanitation, State Board of Health of Minnesota.

There are two chlorine gas machines, one in operation and the other held in readiness in case of trouble. To date but very little trouble has been experienced with this apparatus. At first several renewals of the control valve were necessary, but this was entirely the fault of the operators putting too much tension on the valve when closing.

Dependence is not placed so much on the parts per million of chlorine fed to the suction of the pump as on getting sterile plates. In the laboratory in connection with the plant, bacteriological examinations are made daily, unless very evidently unnecessary, and the aim is to get sterile plates at all times. Generally the plates are sterile, but at times a count of one or two colonies per cubic centimeter is found. The tests for B. coli on the water after chlorination are negative at all times. The laboratory with equipment was planned by the State Board of Health, and the author is indebted to Mr. H. A. Whittaker for his assistance and service in this connection.

While conditions are somewhat similar in all of the towns of the Iron Range, the variations are such as to require the most careful analysis of the situation in any locality in order to determine the best solution of the problems found in each case. This suggests the advisability of the attendance of all Range Superintendents at the meetings of the Minnesota Section, for their active participation would make available to all the experiences of each in the solution of his problem to furnish to his community an adequate supply of pure water with the greatest economy consistent with excellent service.